

Appl. No. 09/820,068
Response dated April 19, 2004
Reply to Office Action of 12/19/2003

REMARKS

This response is being submitted within four months of the mailing date of the Office Action outstanding. A Request for a One Month Extension of Time is enclosed herewith. Applicants request the fee for the Extension of Time be deducted from Applicants' Deposit Account No. 19-1457.

35 U.S.C. §102

Claims 1, 2, 4, 5, 8, 9, and 10 were rejected under 35 U.S.C. §102(e) as being anticipated by Danek et al. (U.S. 6,534,404). Claims 2, 4, 5, 8, depend from independent claim 1, while claim 10 depends from independent claim 9.

To anticipate a claim, the reference must teach each and every element of the claim. The elements must be arranged as in the claim. *MPEP* 2131.

Referring now to independent claim 1, Danek et al. does not disclose subjecting said barrier metal to a non-plasma atmosphere chosen from the group consisting of: an ambient vacuum, hydrogen gas, argon gas and helium gas. Danek et al. discloses the use of silane (Si_2H_6 , Si_3H_8 , $\text{SiH}_n\text{X}_{4-n}$, where X is a halide). Although silane is composed, in part, of elemental hydrogen, this does not anticipate an atmosphere of hydrogen gas. A silane atmosphere is does not anticipate a hydrogen gas atmosphere.

Danek et al. does not disclose subjecting said barrier metal layer to a temperature greater than 200 degrees Celsius. The reference to the processing temperature of 325 degrees Celsius provided at line 61, column 3, refers to the new wafer placed in station 1. While the new wafer is being heated, the other wafers are deposited with TiN, line 62, column 3. Since the new wafer in station 1 has not yet had the barrier metal layer (TiN) deposited onto it, said

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barrier metal layer is not being subjected to a temperature greater than 200 degrees Celsius, as suggest in the rejection.

Since Danek et al. fails to disclose all of the elements of independent claim 1, as arranged in claim 1, it fails to anticipate independent claim 1.

Accordingly, applicants respectfully request allowance of claim 1.

Dependent claim 2 should also be allowable, as Danek et al does not anticipate claim 2. As discussed above the reference to 325 degrees Celsius, refers to the new wafer prior to formation of a barrier metal layer and therefore cannot anticipate a claim to subjecting that temperature to the barrier metal layer.

Dependent claim 4 should also be allowable for the reasons stated above in connection with claim 1. Further, Danek et al. discloses treating a TiN layer in silane at a pressure of 0.1 – 100 Torr, preferably 2 Torr. This does not anticipate an element subjecting the barrier metal layer to a pressure of 0.1 to 20 Torr in a non-silane atmosphere as indicated in claim 1, from which claim 4 depends.

Dependent claim 5 should also be allowable for the reasons stated above in connection with claim 1. Further, the rejection indicated that Danek et al. disclosed a time of 5-60 seconds as a post deposition thermal treatment in lines 51-52, column 3. No time is provided at lines 51-52 of column 3, and as discussed above this thermal treatment is prior to deposition of TiN, so should not properly be characterized as a post deposition thermal treatment.

Dependent claim 8 depends from independent claim 1, and is therefore not anticipated by Danek et al. as indicated above. Applicants respectfully request allowance of dependent claims 2, 4, 5 and 8.

Regarding independent claim 9 and dependent claim 10, Danek et al. does not disclose subjecting said barrier metal to a non-plasma atmosphere

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chosen from the group consisting of: an ambient vacuum, hydrogen gas, argon gas and helium gas. Danek et al. discloses the use of silane (Si_2H_6 , Si_3H_8 , $\text{SiH}_n\text{X}_{4-n}$, where X is a halide). Although silane is composed, in part, of elemental hydrogen, this does not anticipate an atmosphere of hydrogen gas. A silane atmosphere is does not anticipate a hydrogen gas atmosphere.

Danek et al. does not disclose subjecting said barrier metal layer to a temperature greater than 200 degrees Celsius. The reference to the processing temperature of 325 degrees Celsius provided at line 61, column 3, refers to the new wafer placed in station 1. While the new wafer is being heated, the other wafers are deposited with TiN, line 62, column 3. Since the new wafer in station 1 has not yet had the barrier metal layer (TiN) deposited onto it, said barrier metal layer is not being subjected to a temperature greater than 200 degrees Celsius, as suggest in the rejection.

Since Danek et al. fails to disclose all of the elements of independent claim 9, as arranged in claim 9, it fails to anticipate independent claim 9. And further since claim 10 depends from claim 9, it is not anticipated by Danek et al. Accordingly, applicants respectfully request allowance of claims 9 and 10.

35 U.S.C. §103

The Examiner bears the initial burden of establishing a *prima facie* conclusion of obviousness. To establish a *prima facie* case of obviousness, three basic criteria must be met. There must be some teaching or suggestion to modify the reference or combine reference teachings. There must be a reasonable expectation of success. The prior art reference must teach or suggest all claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not

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based on applicants' disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Claims 6 and 11 were rejected based on Danek et al. in view of Wang et al. Claim 6 depends from independent claim 1 and includes all of its limitations. The rejection relies primarily of Danek et al. and introduces Wang et al. to address the missing trench width limitation, not found in Danek et al. However, Danek et al. does not teach or support the elements as arranged in claim 1, as discussed above in connection with the 102 rejection based on Danek et al., and there is no suggestion that Wang et al. provides the necessary teaching to support an obviousness rejection of claim 1 or claim 6 in combination with Danek et al.. Claims 9 and 11 are non-obvious for similar reasons.

Claim 7 was rejected based on Danek et al. in view of Van et al. Claim 7 depends from independent claim 1 and includes all of its limitations. The rejection relies primarily of Danek et al. and introduces Van et al. to address the missing adhesion properties, not found in Danek et al. However, Danek et al. does not teach or support the elements as arranged in claim 1, as discussed above in connection with the 102 rejection based on Danek et al., and there is no suggestion that Van et al. in combination with Danek et al. provides the necessary teaching to support an obviousness rejection of claim 1 or claim 7. Furthermore, the presence of a test for testing adhesion may teach or suggest the desirability of having improved adherence properties, this does not mean that it teaches the method of achieving that result as required by claim 7, which incorporates all of claim 1 from which it depends. Claim 7 requires that the copper film prepared using the steps of claim 1 has the desired adhesion characteristics. The desirability of the adhesion characteristics does not render the method of achieving that result obvious.

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Claims 21-22 were rejected as obvious based on Tsai et al. Tsai et al. teaches away from the method of claim 21 as it teaches the use of an adhesion layer 112 being coated over the treated surface 112, in lines 30 – 31, column 4. Applicants claim 21 does not require this additional adhesion layer. The elimination of this additional requirement is not taught or suggested by Tsai et al. It would not have been obvious based upon Tsai et al. to use a surface treatment process without an additional adhesion layer. Claim 22 depends from claim 21 and is therefore non-obvious as well.

REPLY TO REPOSENSE TO ARGUMENTS

Applicants acknowledge that the Itoh et al. reference has been withdrawn.

Since the Examiner bears the initial burden of establishing a *prima facie* rejection, Applicants conclude that the McTeer reference has also been withdrawn since the contents of the paragraph surrounding line 55 does not definitively determine whether McTeer meant the barrier layer and/or the copper layer, regarding the hydrogen. Since McTeer is not definitive on this point it cannot support a *prima facie* rejection.

Regarding Tsai et al. it has been asserted that Tsai et al. say nothing about their nitrogen treatment being reactive. But as the Examiner bears the initial burden, the fact that Tsai et al. says nothing about its nitrogen treatment being non-reactive fails to support the rejection of a claim requiring a non-reactive gas. Furthermore, one of ordinary skill in the art would understand that a nitrogen plasma as described would be inherently reactive with the silicon carbide material described in Tsai et al. Accordingly, for these reasons as well as

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those discussed above, Tsai et al. fails to support the rejection of claims 21 and 22.


Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

Date:

4/19/04

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